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(54) IMPROVED PISTON FOR A PROGRESSIVE-ACTING PNEUMATIC PISTON AND CYLINDER DEVICE

(71) We, LA INDUSTRIAL PLASTICA Y METALURGICA, S.A., a Spanish Body Corporate, of C/Vitoria, 8, Areta-Llodio (Alava), Spain, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

The invention relates to a piston for a progressive-acting pneumatic piston and cylinder device and has as an object the provision of such a piston in an improved form.

According to the invention there is provided a piston for a progressive-acting pneumatic piston and cylinder device, comprising a generally cylindrical body, having a frusto-conical portion at one end, a discoidal body and a resilient plate between the cylindrical body and the discoidal body and seatable against said one end of the cylindrical body, the cylindrical body having a central axially extending aperture for receiving a piston rod, an angular depression and an arcuate recess in said one end of the cylindrical body, the angular depression having a flat bottom and opening into the frusto-conical portion of the cylindrical body, the arcuate recess being concentric with said one end of the cylindrical body and having opposite ends spaced from the angular depression, a first axially extending through hole communicating at one end with a radially inner portion of the angular depression and a plurality of axially extending further through holes circumferentially spaced apart from each other and from the first through hole, each further through hole communicating at one end with the arcuate recess, and the discoidal body being provided with a plurality of circumferentially spaced by-pass holes.

Preferably the one end of each of the further through holes is adjacent the radially inner wall of the arcuate recess.

Preferably, the first through hole has a restriction therein.

Conveniently, the first and further through holes are equi-angularly spaced.

Advantageously, said one end of the cylindrical body is inwardly dished, the dished end having a frusto-conical rim extending from the periphery of the one end of the cylindrical body to the circle on which the centres of first and further holes lie, and a flat bottom.

Conveniently, the centres of the by-pass holes in the discoidal body and the through holes in the cylindrical body lie respectively on circles of equal diameter.

Preferably, the cylindrical body has a peripheral groove in which a sealing ring is mounted.

Conveniently, the cylindrical body comprises two coaxial parts, one end of one of the parts being radially inwardly stepped and engaging the other part so as to define said peripheral groove.

Conveniently, a washer of smaller diameter than the discoidal body and the resilient plate is interposed between the discoidal body and the resilient plate.

Alternatively, the discoidal body may have a radially inner axially extending projection which engages the resilient plate.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a plan view of one embodiment of a piston according to the invention;

Figure 2 is a sectional side view of one version of the piston of Figure 1 housed in a cylinder and shows the piston moving from right to left;

Figure 3 shows the piston and cylinder of Figure 2 with the piston moving from left to right;

Figure 4 is an exploded view of a preferred version of the piston of Figure 1;

Figure 5 is a section of the main part of the cylindrical body of the piston taken along line A-B of Figure 1;

Figure 6 is a detailed section taken along line C-D of Figure 1;

Figures 7 and 8 are plan and sectional views respectively of the other part of the cylindrical body of th piston;

Figures 9 and 10 are plan and sectional views respectively of a preferred form of the

discoidal body of the piston; and

Figure 11 is a sectional view of the preferred embodiment of the piston.

Referring to Figures 1-3, there is shown therein a piston mounted for slidable movement in a cylinder 4. The piston includes a generally cylindrical body 1 having a frusto-conical portion 7 at one end and a central axially extending aperture 2 receiving one end of the piston rod 3.

The cylindrical body has an angular depression 6 and an arcuate recess 5 in said one end. The depression 6 has a flat bottom and opens into the frusto-conical portion 7 of the body 1. The arcuate recess 5 is concentric with the one end of the body 1 and terminates at opposite ends short of the depression 6 as can be seen clearly in Figure 1. A first axially extending through hole having opposite end portions 8 and 9 and a restriction 10 therebetween communicates at the end portion 8 with the inner vertex (or radially innermost portion) of the depression 6.

A plurality of axially extending further through holes 11 are formed in the body 1. The holes 11 are circumferentially spaced apart from each other and from the first through hole, all holes being equi-angularly spaced. The holes 11 are aligned with the radially inner wall of the recess 5 and communicate with the recess 5.

The body 1 has a peripheral groove 14 accommodating a ring gasket 15 which seals against the inner wall of the cylinder 4.

The piston also includes a resilient plate 12, a washer, and a discoidal body 13. The resilient plate 12 and washer 13 are disposed between the body 13 and the body 1 with the washer on the side of the plate 12 adjacent to the body 13. The bodies 1 and 13, the washer and the plate 12 each receive one end of the piston rod 3 and are clamped together between a shoulder on the piston rod and a nut screw-threaded on the end of the piston rod. The diameter of the washer is much less than the diameter of the plate 12 so that the outer portion of the latter can flex away from the body 1, with which it normally engages, towards the body 13. The discoidal body 13 has a diameter which is slightly smaller than the inner diameter of the cylinder 4 so that an annular passage is provided between the body 13 and the cylinder 4. Moreover, the discoidal body 13 has a plurality of circumferentially spaced by-pass holes 16 the centres of which and the centres of the through holes in the body 1 lie on circles of equal diameter.

A preferred version of the piston will now be described with reference to Figures 1 and 4-11. The principal difference b tween the preferred version and the version previously described resides in making the cylindrical body in two co-axial parts 17 and 18. Also the washer is omitted and instead the discoidal body, now indicated by the reference numeral 19 has a radially inner portion which projects axially beyond the radially outer portion and which engages the resilient plate 12.

The parts 17 and 18 are each provided with a plurality of through holes 21 and 20 respectively. The centres of the holes 21 and the centres of the holes 20 lying respectively on circles of equal diameter. The advantage of making the cylindrical body in two parts is that it facilitates manufacture of the peripheral groove for accommodating the ring gasket indicated in Figure 11 by the reference numeral 23; this groove is now formed by providing the part 17 with a radially inward step as shown at 22.

Also as clearly shown in Figures 5 and 11, one end of the part 17, i.e. that end which constitutes a seat for the resilient plate 12, is slightly inwardly dished, the dished end having a frusto-conical rim extending from the periphery of the one end to the circle on which the centres of the holes 21 lie, and a flat bottom.

The piston operates as follows:

When the piston moves from right to left as shown in Figure 2 by the broad arrow, fluid in chamber X urges the resilient plate against the one end of the cylindrical body 1 thereby closing the holes 11 and fluid can only pass to chamber Y *via* the angular depression 6 and the hole 8, 9, 10. Hence, the piston will move relatively slowly and this slow movement is transmitted by the piston rod 3 to an element joined thereto, causing it, therefore, to move slowly too.

When the direction of movement of the piston is reversed, i.e. as indicated by the broad arrow in Figure 3 fluid in chamber Y will pass to chamber X *via* all the holes 11 and the hole 8, 9, 10 in the cylindrical body 1 since the radially outer portion of the resilient plate 12 will flex towards the discoidal body 12, 19. Hence, the piston will move much faster in this direction as will the element connected thereto by the piston rod 3.

WHAT WE CLAIM IS:

1. A piston for a progressive-acting pneumatic piston and cylinder device, comprising a generally cylindrical body having a frusto-conical portion at one end, a discoidal body, and a resilient plate between the cylindrical body and the discoidal body and seatable against said one end of the cylindrical body, the cylindrical body having a central axially extending aperture for receiving a piston rod, an angular depression and an arcuate recess in said one end of the cylindrical body, the angular depression having a flat bottom and opening into the frusto-conical portion of the cylindrical body, the arcuate recess being concentric with said one end of the cylindrical body and having

opposite ends spaced from the angular depression, a first axially extending through hole communicating at one end with a radially inner portion of the angular depression and a plurality of axially extending further through holes circumferentially spaced apart from each other and from the first through hole, each further through hole communicating at one end with the arcuate recess, and the discoidal body being provided with a plurality of circumferentially spaced by-pass holes.

2. A piston as claimed in claim 1, wherein the one end of each of the further through holes is adjacent the radially inner wall of the arcuate recess.

3. A piston as claimed in claim 1 or claim 2, wherein the first through hole has a restriction therein.

4. A piston as claimed in any one of the preceding claims, wherein the first and further through holes are equi-angularly spaced.

5. A piston as claimed in any one of the preceding claims, wherein said one end of the cylindrical body is inwardly dished, the dished end having a frusto-conical rim extending from the periphery of the one end of the cylindrical body to the circle on which the centres of first and further holes lie, and a flat bottom.

6. A piston as claimed in any one of the preceding claims, wherein the centres of the by-pass holes in the discoidal body and the through holes in the cylindrical body lie respectively on circles of equal diameter.

7. A piston as claimed in claim 1 or claim 2, wherein the cylindrical body has a peripheral groove in which a sealing ring is mounted.

8. A piston as claimed in claim 7, wherein the cylindrical body comprises two coaxial parts, one end of one of the parts being radially inwardly stepped and engaging the other part so as to define said peripheral groove.

9. A piston as claimed in any one of the preceding claims, wherein a washer of smaller diameter than the discoidal body and the resilient plate is interposed between the discoidal body and the resilient plate.

10. A piston as claimed in any one of claims 1-8, wherein the discoidal body has a radially inner axially extending projection which engages the resilient plate.

11. A piston for a progressive-acting pneumatic cylinder, substantially as hereinbefore described with reference to, and as shown in, Figures 1-3 or 4-11 of the accompanying drawings.

12. A progressive-acting pneumatic piston and cylinder device, including a piston as claimed in any one of the preceding claims.

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1602780 COMPLETE SPECIFICATION
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Sheet 1

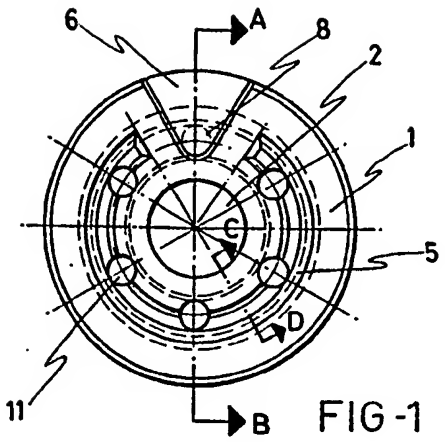

FIG-1

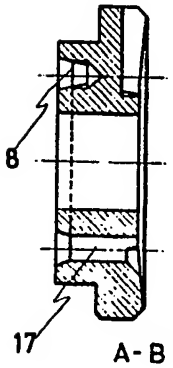

FIG-5

FIG-6

1602780 COMPLETE SPECIFICATION

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Sheet 2

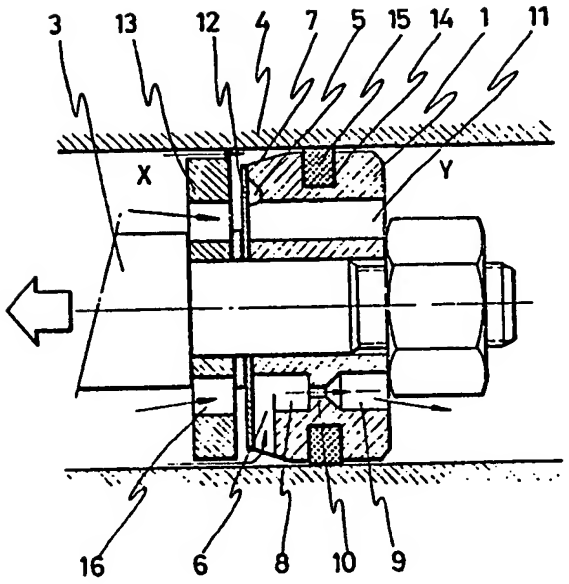

FIG-2

1602780 COMPLETE SPECIFICATION
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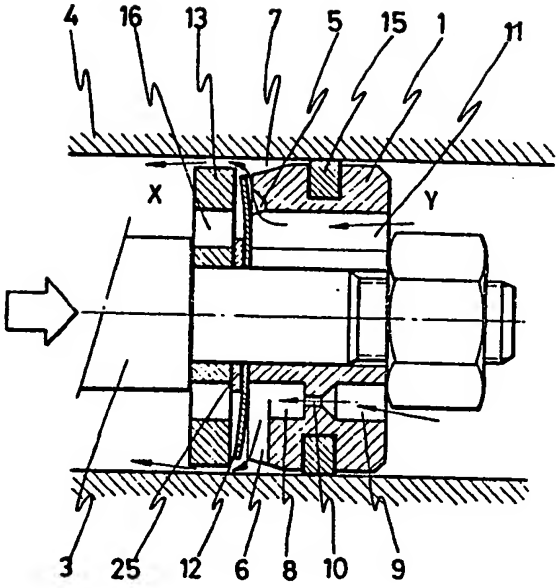

FIG-3

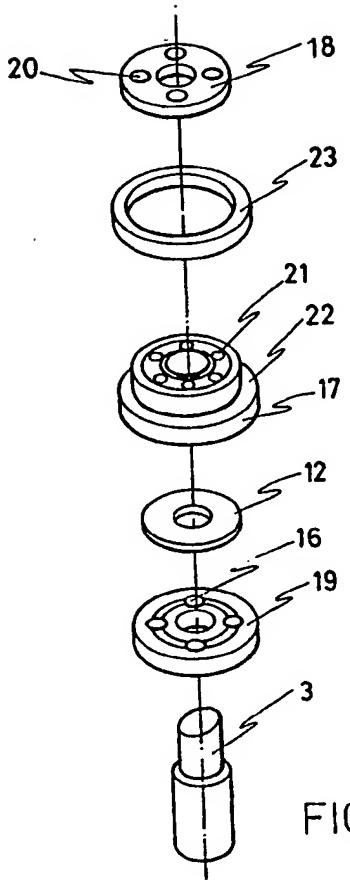

FIG-4

1602780 COMPLETE SPECIFICATION
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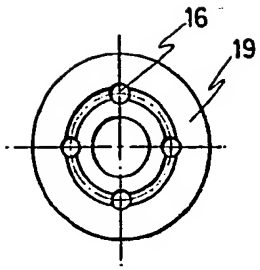

FIG-9

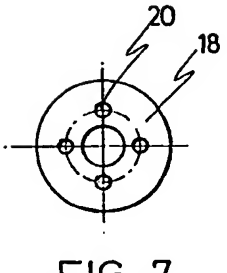

FIG-7

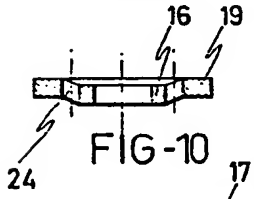

FIG-10

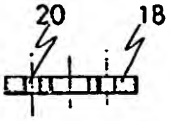

FIG-8

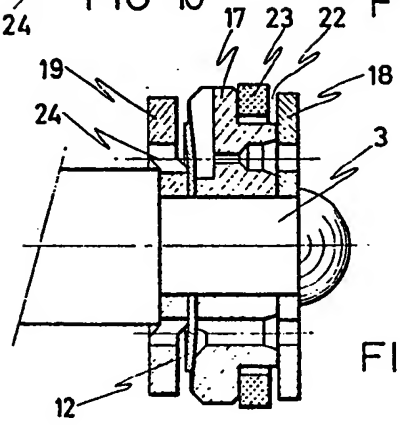

FIG-11